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Method and Apparatus in a Telecommunication System

FIELD OF THE INVENTION

5 The present invention relates to a specific protocol extension scenario, namely the addition of a new system information block (SIB) type in cellular applications that use the Wideband Code Division Multiple Access (W-CDMA) standard as defined by 3GPP.

10 **BACKGROUND OF THE INVENTION**

In the frame of this document it is important to understand the basic architecture of the UTRAN, the structure of interfaces between the different nodes and the structure of physical channels on the radio interface as shown in figure 1. The explanation below introduce the assumed network architecture and some fundamental issues.

20 The User Equipment (UE) is the mobile terminal by which a subscriber can access services offered by the operator's Core Network (CN). In this case the terminal is a dual mode, also acting as Mobile Station (MS). An MS is a GSM mobile terminal by which a subscriber can access services offered by the operator's Core Network (CN).

25 The UTRAN (UMTS Terrestrial Radio Access Network) is the part of the network that is responsible for the radio transmission and control of the radio connection.

The RNS (Radio Network Subsystem) controls a number of Base Stations in the radio access network.

The RNC (Radio Network Controller) controls radio resources and radio connectivity within a set of cells.

The BS (Base Station) handles the radio transmission and reception within one or more cells.

- 5 On the GSM side, the corresponding nodes are as follows:

The BSC (Base Station Controller) controls radio resources and radio connectivity within a set of cells.

The BTS (Base Transmission Station) handles the radio transmission and reception within one or more cells.

- 10 A cell is a geographical area where radio coverage is provided by radio base station equipment at the base station site. Each cell is identified by a unique identity, which is broadcast in the cell.

- 15 Depending on its activity level, the network decides in which the state the UE shall operate. The least active UEs operate in idle mode, in which UTRAN is unaware of the presence of the UE. The CN however is aware of the Location Area (LA)/ Routing Area (RA) in which the UE is located; the UE also informs the CN of changes in LA/ RA. Furthermore, in
20 case an incoming call is to be established, the CN initiates paging in all cells comprising the LA/ RA in which the UE is registered.

- 25 In case the UE becomes active, it operates in connected mode. In this case UTRAN is aware of the UE, for which it employs an individual RRC connection. Connected mode includes the following states, in order of increasing activity level: URA_PCH, CELL_PCH, CELL_FACH, CELL_DCH. In

the first two states the UE is inactive, in URA_PCH UTRAN knows the UE position at UTRAN Routing Area (URA) level while in CELL_DCH UTRAN knows the UE position at cell level. In CELL_FACH the UE is active but operates on a common
5 channel, that is a channel shared with other UEs. In CELL_DCH the UE operates on a dedicated channel, allocated only for that UE.

In CELL_DCH UTRAN controls the mobility of the UE, i.e. it orders the UE to perform measurements and based on that it,
10 e.g., moves the UE to another cell, adds or removes cells from the active set. In the other states however, the UE normally decides which cell to move to, although this cell re-selection process is influenced by parameters provided by the network.

15 UTRAN applies system information to broadcast information relevant for a large number of UEs in a cell, e.g., to control the cell re-selection procedure in a UE. Some of the system information needs to be broadcast more often than others, e.g., because it affects the access delay or because
20 the information changes rapidly. Other system information should be broadcast less frequently given the limited radio resources. To facilitate different scheduling of system information, the system information is partitioned into a number of different system information blocks (SIBs). Each
25 SIB can be scheduled independently. The signalling specified in TS 25.331 identifies a system information block by means of a "SIB type" information element.

The broadcast channel that is used to transfer system information, supports transfer of data units of a fixed
30 size. In order to support system information blocks with a size exceeding this limit segmentation is used. Furthermore, to use the broadcast channel efficiently, concatenation

mechanism is provided. The mechanism basically operates as follows:

(a) System information blocks may be split into a number of different segments,

- 5 (b) a number of segments may be concatenated. The concatenation of a number of segments is called a system information message.

Information about which SIB is broadcast at a certain moment is not only provided within the corresponding segments but also within the scheduling information that is included in the Master Information Block (MIB) and/or one or more Scheduling Blocks (SBs). Although this facility introduces some sort of redundancy, it makes the segmentation more robust and makes it possible for the UE to already decode SIBs even when its scheduling information is not yet available.

The signalling specified in TS 25.331 includes two mechanisms for future extension of all messages: the critical and the non-critical message extension mechanisms.

20 The critical message extension mechanism involves the definition of a new version of the message, which transfer syntax may be completely different from the previous except for the initial part that indicates the version. In case the non-critical message extension is used, the transfer syntax

25 of the existing message is just extended with new information. In this case old receivers will still recognise the entire message apart from the newly introduced extensions.

Since system information messages are broadcast, they cannot be directed only towards mobiles that support a certain

protocol extension. This means that, to maintain backward compatibility, only the non-critical extension message can be used for system information. Furthermore, it is important to note that for system information the extension mechanism

5 has been defined only at the level of the system information blocks. This means that future extension is neither possible at the level of the segments nor at the level of the system information messages.

For parameters, the transfer syntax specifies the range of possible information element values. In some cases, this

10 range range includes a number of spare values that is reserved for future extension. This is also the case for the message type information element. TS 25.331 explicitly specifies that the UE shall ignore broadcast messages

15 (message sent on BCCH) which type it does not comprehend: "If the UE receives an RRC message on the BCCH, PCCH, CCCH or SHCCH with a message type not defined for the logical channel type the message was received on, it shall ignore the message"

20

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the architecture of a Radio Access Network.

25 DESCRIPTION OF THE INVENTION

The present invention concerns a means to introduce new system information block types within the Radio Resource Control (RRC) protocol as defined within 3GPP TS 25.331. Such new block types are needed when in future protocol

30 versions the system information is extended with information

that needs to be scheduled independently using the ^{Huvudföres Kassa} currently defined flexible scheduling mechanism.

In case new system information parameters are defined in future, these may be added to existing system information blocks. If however the new parameters have distinct scheduling requirements and/or specific requirements concerning their validity, it is preferable to create a new system information block for these parameters. This involves using one of the spare values defined for the "SIB type" information element. The "SIB type" information is included in a number of information elements, each with a different number of spare values reserved for future extension:

Within IE "SIB type" used in IE "Xyz segment" and in the IEs "Complete SIB" & "Complete SIB (short)". Currently 32 values have been defined for this IE, of which 2 are spare values

Within IE "SIB and SB Type" used in IE "References to other system information blocks and scheduling blocks", which is included in the MIB. Currently 32 values have been defined for this IE, of which 3 are spare values

20 Within IE "SIB type SIBs only" used in the IEs "SCCPCH Information for FACH" and "References to other system information blocks". Currently 32 values have been defined for this IE, of which 5 are spare values

The most obvious way to extend the SIB type can be characterised as follows: The last spare value is used to indicate that the SIB type is extended and in order to support further extensions in future, a non critical extension is added to the message. In case we would like to add support for an additional 7 SIB types, we need to add a 3-bit field. In this case the first 31 SIB types can be

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signalled by means of the original SIB type, while SIB type 31 up to 37 can be supported by the non-critical extension. Value 7 ('111'B) of the non-critical extension would then be reserved for further extensions.

- 5 However, as mentioned before, future extension for system information is only possible at the level of the system information blocks. This means that the above approach only works fine for the SIB type IEs that are contained in system information blocks. For the SIB type IEs that are included
10 in the segments and in the system information message another approach is needed.

To summarise, the problem can be characterised as follows:

It is only possible to add one additional SIB using the current extension mechanism.

- 15 Due to the lack of extension possibilities at the level of the SYSTEM INFORMATION message and the the level of segments, it is not obvious how additional SIBs should be introduced.

- 20 The present invention discloses three possible embodiments for adding new system information blocks, as described in the following:

Artificial extension within SIB-data field of segments

- 25 This first embodiment can be described as follows: For extended SIB types both within the system information blocks and within the segments the SIB type is set to a special value, e.g., '1111'B, indicating that it concerns an extended SIB type. This ensures that the SIB will be ignored by mobiles not supporting this extension. Within the system

information blocks, a regular extension is added including an additional SIB type extension field, used to distinguish a number of additional SIB types. Within the segments a similar additional field is introduced. This field is created within the original SIB data field

It should be noted that normally the SIB data field only carries the real payload: (part of) a system information block. The embodiment is further illustrated by means of the following modified extract from TS 25.331.

10

| Information Element/Group name | Value | Comment |
|--------------------------------|---------------|-------------------------------------------------|
| Message type | | SYSTEM INFORMATION |
| SFNprime | | Arbitrary value in range (0..4094 by step of 2) |
| CHOICE Segment combination | Combination 2 | |
| >First Segment | | |
| >>SIB type | "1111" | Reserved for extension |
| >>SEG_COUNT | 2 | |
| >>SIB data fixed extension | | |
| >>>SIB type extension | "000" | SIB 20 |
| >>>SIB data xyz | | 219 bits |

Receivers not supporting the extension will just ignore segments corresponding with extended SIB types (based on the value '1111'B within the SIB-type field). This means the embodiment is fully backwards compatible.

- 15 Receivers supporting the extensions should be able to decode the SIB data and know that the first bits actually concern the SIB type extension. This can be done by making the IE SIB type extension conditional on the value of SIB type; it is included if SIB type has value "Reserved for extension".
- 20 In the ASN.1 this can be implemented as follows:

25

```

FirstSegment ::=
-- Other information elements
sib-TypeAndFirstSegment
TypeAndFirstSegment
)
SEQUENCE {
SIB-
CHOICE {
NormalFirstSegment,

```

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| | | |
|----|-------------------------------------|----------------------|
| | systemInformationBlockType1 | NormalFirstSegment, |
| | systemInformationBlockType2 | NormalFirstSegment, |
| | systemInformationBlockType3 | NormalFirstSegment, |
| | systemInformationBlockType4 | NormalFirstSegment, |
| 5 | systemInformationBlockType5 | NormalFirstSegment, |
| | systemInformationBlockType6 | NormalFirstSegment, |
| | systemInformationBlockType7 | NormalFirstSegment, |
| | systemInformationBlockType8 | NormalFirstSegment, |
| | systemInformationBlockType9 | NormalFirstSegment, |
| 10 | systemInformationBlockType10 | NormalFirstSegment, |
| | systemInformationBlockType11 | NormalFirstSegment, |
| | systemInformationBlockType12 | NormalFirstSegment, |
| | systemInformationBlockType13 | NormalFirstSegment, |
| 15 | systemInformationBlockType13-1 | NormalFirstSegment, |
| | systemInformationBlockType13-2 | NormalFirstSegment, |
| | systemInformationBlockType13-3 | NormalFirstSegment, |
| | systemInformationBlockType13-4 | NormalFirstSegment, |
| | systemInformationBlockType14 | NormalFirstSegment, |
| 20 | systemInformationBlockType15 | NormalFirstSegment, |
| | systemInformationBlockType15-1 | NormalFirstSegment, |
| | systemInformationBlockType15-2 | NormalFirstSegment, |
| | systemInformationBlockType15-3 | NormalFirstSegment, |
| | systemInformationBlockType16 | NormalFirstSegment, |
| 25 | systemInformationBlockType17 | NormalFirstSegment, |
| | systemInformationBlockType15-4 | NormalFirstSegment, |
| | systemInformationBlockType18 | NormalFirstSegment, |
| | schedulingBlock1 | NormalFirstSegment, |
| | schedulingBlock2 | NormalFirstSegment, |
| 30 | systemInformationBlockType15-5 | NormalFirstSegment, |
| | systemInformationBlockType19 | NormalFirstSegment, |
| | reservedForExtension | ExtendedFirstSegment |
| |) | |
| 35 | ExtendedFirstSegment ::= SEQUENCE (| |
| | -- Other information elements | |
| | seg-Count | SegCount, |
| | sib-TypeExt | SIB-TypeExt, |
| | sib-Data-fixed2 | SIB-Data-fixed2 |
| |) | |
| 40 | NormalFirstSegment ::= SEQUENCE (| |
| | -- Other information elements | |
| | seg-Count | SegCount, |
| | sib-Data-fixed | SIB-Data-fixed |
| 45 |) | |

It should be noted that the scheduling of system information has been optimised so that in case a segment takes an entire TB no size information is included. This is implemented by means of separate values for the CHOICE parameter

50 "Segmentation combination". This has resulted in a large number of ASN.1 definitions, mainly for the purpose of size optimisation. The use of the above approach would not only significantly increase the large number of ASN.1 lines but also further increases the scheduling complexity (since the

55 number of payload bits is different for an extended SIB due to the additional SIB type extension field).

The previously mentioned significant increase in ASN.1 lines could be avoided by not explicitly reflecting in the ASN.1 the presence of the SIB-TypeExt at the start of SIB-Data,

e.g., by just inserting a comment. However, this also involves inclusion of additional SIB-type information in every segment, which implies that the overhead increases.

Extended SIB- type details only in scheduling information

- 5 This second embodiment can be described as follows: For extended SIB types both within the system information blocks and within the segments the SIB type is set to a special value, e.g., '1111'B, indicating that it concerns an extended SIB type. This ensures that the SIB will be ignored
- 10 by mobiles not supporting this extension. Within the system information blocks, a regular extension is added including an additional SIB type extension field, used to distinguish a number of additional SIB types. For instance, in case 3 bits are reserved 7 additional SIB types can be supported.
- 15 Within the segments no such additional field is introduced.

The merits of this embodiment are as follows: This embodiment is still fully backwards compatible, it is more efficient since it involves the additional overhead in every segment, it avoids the explosion in ASN.1 type definitions,

20 and the existing scheduling algorithms are not affected.

The embodiment requires an additional mechanism to allow the scheduling of multiple extended SIB type at the same time and within the same SYSTEM INFORMATION message. The details of which extended SIB type is included in a segment is

25 included in the scheduling information. In case multiple extended SIB types are included in a SYSTEM INFORMATION message, the scheduling information should clarify the SIB type for each of those. This can be done by including additional information in the scheduling information or by

30 defining a fixed rule, e.g., that the order used in the

SYSTEM INFORMATION message is the same as the one used in the scheduling information.

Extended SIB- type details only in scheduling information

5 This third embodiment can be described as follows: For
extended SIB types both within the system information blocks
and within the segments the regular SIB type field is used
distinguish the additional SIB types. Within the system
information blocks, a regular extension is added including
an additional code set field, indicating how the SIB type
10 should be interpreted. This alternative scheme very much
resembles the code set shift mechanism as used in some other
protocols, e.g. ISDN. This means value 0 would mean SIB type
1 in code set 1 and SIB type 20 in code set 2. Within the
segments no additional fields are introduced.

15 As compared to the previous mechanism this embodiment can be
characterised as follows: This embodiment is not backwards
compatible since the interpretation of a given SIB type
depends on information provided in an extension that earlier
mobiles do not support. As a result, these mobile will
20 interpret the information incorrectly. This scheme does not
really require additional mechanisms to support scheduling
of multiple extended SIB type at the same time; within the
same SYSTEM INFORMATION message. The only restriction that
applies is that SIBs with the same value within the SIB type
25 field should not be scheduled together. This is not
considered to be an acceptable restriction, that could
anyhow be resolved in a manner as described for the second
embodiment.

30 The invention includes a number of embodiments for adding
new system information block type. All mechanisms solves the

unclarify of how to add system information blocks, while each has its own specific merits:

In the first embodiment the segments can still be decoded and processed without considering the scheduling information. The second embodiment is more efficient since it does not involve the additional overhead in every segment, it avoids the explosion in ASN.1 type definitions, and it does not affect the existing scheduling algorithms. The same as for the second embodiment is also valid for the third embodiment. No additional mechanism is required to support scheduling of multiple extended SIB type at the same time/ within the same SYSTEM INFORMATION message.

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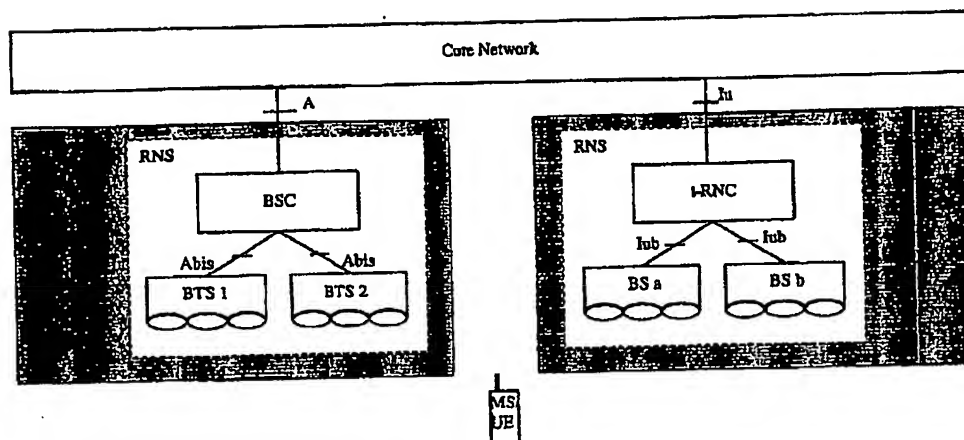


Figure 1

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